

Statement A

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FY 1970

RDT&E, Defense Agencies

Supporting Information

(31 December 1968)

NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical

Major Objectives:

To define and evaluate human response and vulnerability to the effects of nuclear weapons and to prevent, mitigate, or delay that response through improved understanding of the mechanism of injury and advances in prophylaxis, diagnosis, prognosis and treatment of the three basic types of injuries produced and the many variant degrees and combinations that would occur in the free and non-free field environment. Detailed human response data are vital in assessing man's limitations as related to weapons systems vulnerability studies and strategic/tactical doctrine for their employment.

- a. To evaluate the dose-time-effect of radiation on human performance, as it relates to sensory, psychologic, perception, coordination, discrimination and memory functions.
- b. To define the dose-time-effect of pulsed fission radiation on primate performance, and quantify the contribution of dose rate, Quality Factor and depth dose profile to subsequent Early Transient Incapacitation and other aspects of Performance Decrement; and then correlate human and animal data in order to provide optimum extrapolation of animal response to man's performance as related to specific tasks and weapons systems.
- c. To determine safe thermal exposure levels for human eyes; and establish safe separation distances for all yield and height of burst possibilities for weapons testing hazard evaluation.
- d. To develop flashblindness prediction models useful to all operational elements of the Armed Forces; and assist in the development of flashblindness protective materials/devices.
- e. To define and assess the interrelationship of combined injury (blast, thermal, radiation and other stresses) as it pertains to human performance, combat effectiveness, casualty estimates, diagnosis, prognosis and treatment.
- f. To acquire advanced knowledge and expertise in diagnosis, prophylaxis and treatment of thermal skin burns.
- g. To provide valid biological criteria for non-free field blast (primary, secondary and tertiary) effects related to military requirements for protection design criteria, casualty estimation, and treatment regimes.
- h. To identify and define physiological sites and amount of radiation injury so as to improve prevention, prophylaxis, diagnosis and treatment of radiation injuries in man.

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NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical (continued)

Program:

a. Present State of Knowledge:

(1) Although human radiation accidents provide some information about effects of varying types and doses of radiation, they contribute little concerning performance capabilities of patients. Incomplete dosimetry data further limits application to the military case. Primates exposed to pulsed, fission doses of 5000 rads have displayed varying degrees of performance decrement, followed by a variable recovery period when performance may approximate pre-exposure values. Decrement appears proportional to dose and task complexity; however, the contributions of dose rate, neutron/gamma ratio and depth dose distribution are not clearly defined. Although a 5 Kg. monkey may perform certain tasks, he is not apriori, equivalent to a 70 Kg. man. Thus, extrapolating animal data to man requires multi-species comparisons and correlation with human data.

(2) Threshold retinal burn data on rabbits are available for 165 microsecond through 10 second exposures, and for retinal image sizes of 100 microns through 1 millimeter. A limited amount of data has been collected for image sizes smaller than 100 microns and exposure times less than 165 microseconds. Preliminary primate threshold data can be compared with rabbit data and assist in extrapolation to, and comparison with, the very limited human data. Flashblindness recovery data is now sufficient to develop preliminary flashblindness prediction models for some military operational environments and to test operating characteristics of flashblindness protective devices. A totally satisfactory protective device is not available. The goldplated goggle/visor is available for daylight use. The U. S. Navy has delayed issue of the Explosive Lens Filter (ELF) to fleet aircraft due to faulty triggering. A new modified goggle system is being evaluated by the Navy, and a modification is being considered for use in the Main Battle Tank. Other protective materials under study are sub-microscopic dipoles, semi-conductor materials, and a reversible electroplating technique.

(3) Although considerable biological data are available for single source free field stresses (blast, thermal, radiation), knowledge of combined injury is limited and insufficient to adequately predict human performance, morbidity, and survival time. Although much free field blast data for primary, secondary and tertiary effects on man have been obtained, additional information is required for the non-free field environment, i. e., foxholes, shelters. Various configurations of partial body radiation shielding have shown a significant increase in large animal survival, and suggest that sufficient head shielding may ameliorate or abolish the early transient

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NUCLEAR WEAPONS EFFECTS RESEARCH

## (M) Medical (continued)

incapacitation noted in exposed primates. The effects on large mammals of multiple sublethal doses at varying dose rates are being evaluated in recovery/residual injury experiments. Radiation effects data are incomplete for numerous biological subsystems, critical tissues and mechanisms of injury. In order to properly answer vital questions posed by service requirements, this basic information must be obtained.

b. Plans for FY 70:

In general, the FY 70 Medical NWER Program is designed to provide data required as specified in the objectives above. Coordinated tri-laboratory research effort on primate performance is complemented by three human research programs. Biological data acquired in the other related areas will be extrapolated to man. Thermal exposure of primate eyes will be incorporated in burn prediction model for determination of safe human exposures. Flashblindness recovery data will be expanded to meet additional exposure and operational environments. Energy intensities too high to be considered absolutely safe, but which do not produce visible lesions will be investigated. The dynamics of the bleaching and regeneration of retinal photopigments will enable prediction of visual effects. Morbidity, mortality and death distribution in animals exposed to combinations of blast, thermal and radiation stresses will be completed emphasizing determination of pathophysiological mechanisms. Evaluation of the effect of combined injury on primate discrimination and physical endurance will be studied. Combined injury therapy and biological criteria for non-free field blast environments will be continued, as will mechanism of injury and critical sites of radiation damage studies. Studies on the effects of high energy neutrons on large animals utilizing a cyclotron at the Naval Radiological Defense Laboratory will be pursued. Partial shielding studies against fission radiation are programmed, and research efforts on radiation injury to the immune system will be intensified.

c. Systems Application:

Man's performance is intimately tied, directly or indirectly, to all known weapons systems. The degree and duration of functional impairment resulting from prompt doses of fission radiation is of vital importance to DOD, all the Services and weapons and systems designers. General Dynamics requested incapacitation doses, times to onset and recovery for their Fill vulnerability study. MITRE Corporation also requested information on man's vulnerability/functional capacity for the C5A Advanced Airborne Command Post. The value of establishing a mission completion dose

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NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical (Cont'd)

range and sure kill radiation levels expressed in percent probability is obvious for strategic aircraft. Flash-blindness and protective materials research are primarily directed toward increasing probability of strategic mission completion by manned aircraft of the U. S. Forces and by tactical support elements of all services. Retinal burn research provides vital data necessary for hazard evaluation in support of all standby Nuclear Weapon Test Programs. Data on mechanism of injury, sites of radiation damage, recovery rates and dose-time-quality relationships provide a basis to harden man for command post functions and weapon system employment. Partial body shielding of select areas and/or prophylaxis with combinations of radioprotective drugs may abolish the early transient incapacitation produced by prompt weapon radiation.

Funding Summary

FY 1968

4,604

FY 1969

4,283

FY 1970

4,119

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DEPARTMENT OF DEFENSE

Appropriation: RDT&E, Defense Agencies  
Agency: Defense Atomic Support Agency

DOD NUCLEAR WEAPONS EFFECTS RESEARCH PROGRAM

	(M) Medical	(Thousands of Dollars)
Task		FY 1970 Program
MA : Biomedical Effects: Incapacitation, Performance Decrement and Combined Injury		1,316
MB Biomedical Effects: Ocular and Thermal Injury		399
MC Biomedical Effects: Radiation Injury		1,800
MD Biophysics of Radiation Injury		504
ME Analysis and Application of Biomedical Effects Data		100
	TOTAL	<u>4,119</u>

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NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical

(Thousands of Dollars)

Task & Subtask No.	Title	Respon- sible Agency	Agency Performing Work	FY 1968 Program	FY 1969 Program	FY 1970 Program
MA	<u>Biomedical Effects: Incapacitation, Performance Decrement &amp; Combined Injury</u>					
MA 008	Radiation Effects on Sensory and Motor Functions	OSG	WRAIR	-0-	5	5
MA 012	Biological Effects of Blast from Bombs	DASA	LLACE	130	150	90
MA 067	Performance Decrement	AFWL	USAFSAM	28	125	135
MA 112	Biological Response to Combined Effects	DASA	LLACE	370	350	375
MA 153	Radiation and Human Performance	OSG	WRGH	49	42	30
MA 165	Neurophysiological and Behavioral Effects of Incidental Irradiation of "Normal" Humans	DASA	LBVAH	-0-	30	44
MA 170	Split Dose Fission Irradiation Effects on Mammalian Performance	DASA	CORNU	18	15	-0-
MA 904	Behavioral Decrement & Incapacitation Response to Acute Radiation Injury	DASA	AFRRI	658	492	637
MA 905	The Physiological Correlates of Acute Radiation Injury	DASA	AFRRI	240	30	-0-
			Subtotal	1,493	1,239	1,316

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NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical (Cont'd)

Task & Subtask No.	Title	Respon- sible Agency	Agency Performing Work	FY 1968 Program	FY 1969 Program	FY 1970 Program
<u>MB Biomedical Effects: Ocular and Thermal Injury</u>						
MB 001	Oculo-Visual Effects Physical Stimulus	NASL	NASL	103	50	50
MB 002	Retinal Injury & Flashblindness	DASA	MCVA	65	70	55
MB 003	Thermal Radiation Damage on the Eye and Eye Protection	AFWL	USAFSAM	50	50	50
MB 013	Physiological Effect of Photo Stress Upon Retinal Function	DASA	MIAMI	-0-	10	10
MB 033	Biochemical and Immunological Changes Associated with Thermal Injury	DASA	MCSC-DS	-0-	80	84
MB 055	Flashblindness Recovery & Ocular Visual Effects	NASC	NADC	50	95	-0-
MB 062	Physical Mechanisms of Thermal Injury	NASL	NASL	50	40	-0-
MB 134	Eye Effects Safe Separation Charts	USAFSAM	T. I.	50	35	25
MB 137	Visual Decrement Following Thermal Injury to the Eye	AFWL	ARL	95	90	95
MB 149	Research in Pupillary Mechanisms & Flashblindness	DASA	POLC	33	-0-	-0-
MB 151	Flashblindness Protective Development	DASA	RCA-DSRC	100	-0-	-0-
MB 166	Photostress, Recovery and Macular Function	DASA	U of CALIF	39	20	30
MB 167	Ocular Effects from Intense Light Using Reflectometer	DASA	TECH INC	65	38	-0-
MB 168	Nuclear Flash Protective Device	USAFSAM	TEEG	-0-	-0-	-0-
			Subtotal	<u>700</u>	<u>578</u>	<u>399</u>

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NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical (continued)

(Thousands of Dollars)

Task & Subtask No.	Title	Respon- sible Agency	Agency Performing Work	FY 1968 Program	FY 1969 Program	FY 1970 Program
<u>MC Biomedical Effects: Radiation Injury</u>						
MC 009	Metabolic Changes in Humans Following Body Irradiation	DASA	CINNGH	71	65	75
MC 030	Responses of Large Mammals to Acute Whole Body Irradiations	AFWL	AFWL	70	-0-	45
MC 035	Lethality and Recovery from Radiation Injury	NRDL	NRDL	270	238	-0-
MC 068	Diagnosis, Prophylaxis & Therapy	AFWL	USAFSAM	18	-0-	55
MC 121	Partial Body Irradiation	AFWL	AFWL	50	-0-	45
MC 157	Radiation, Inflammation & Infection	OSG	JHU	30	25	21
MC 161	The Effect of Higher Energy Neutron Irradiation on Mammalian Systems	NRDL	NRDL	-0-	100	-0-
MC 164	Partial Body Irradiation: Biological Effects of Shielding	NRDL	NRDL	-0-	30	-0-
MC 171	Interspecies Comparison of Recovery from Acute Radiation Injury	NRDL	NRDL	-0-	-0-	50
MC 172	Recovery at Organ Level	NRDL	NRDL	-0-	-0-	75
MC 173	Accumulation of Injury and Recovery from Protracted Irradiation	NRDL	NRDL	-0-	-0-	75
MC 900	The Clinical Responses of the Total Animal to Acute Radiation Injury	DASA	AFRRI	105	99	113

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NUCLEAR WEAPONS EFFECTS RESEARCH

(M) Medical (Continued)

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Task & Subtask No.	Title	Respon- sible Agency	Agency Performing Work	FY 1968 Program	FY 1969 Program	FY 1970 Program
<u>MC Biomedical Effects: Radiation Injury(Cont'd)</u>						
MC 901	The Biochemical Study of Acute Radiation Injury	DASA	AFRRI	212	358	272
MC 902	The Cellular and Subcellular Level Study of Acute Radiation Injury	DASA	AFRRI	178	116	122
MC 903	Organ and System Response to Acute Radiation Injury	DASA	AFRRI	582	580	686
MC 906	Clinical Evaluation & Therapy of Acute Radiation Injury	DASA	AFRRI	114	159	166
			Subtotal	<u>1,700</u>	<u>1,770</u>	<u>1,800</u>
<u>MD Biophysics of Radiation Injury</u>						
MD 156	A Low Field Electron Spin Resonance Study of the Effects of Ionizing Radiation in Living Animals	DASA	SWRI	70	-0-	-0-
MD 907	The Biophysical Aspects of Acute Radiation Injury	DASA	AFRRI	516	557	447
MD 908	Operational Physics Contribution to AFRRI Radiobiology Research	DASA	AFRRI	75	109	57
			Subtotal	<u>661</u>	<u>666</u>	<u>504</u>
<u>ME Analysis and Application of Biomedical Effects Data</u>						
ME 110	Analysis of Medical NWER & NWET Data	DASA	(UNK)	-0-	30	100
ME 169	Thermal Radiation Skin Burn Summary	NASL	NASL	50	-0-	-0-
			Subtotal	<u>50</u>	<u>30</u>	<u>100</u>
			Total	<u>4,604</u>	<u>4,283</u>	<u>4,119</u>

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